Autodesk

Autodesk Moldflow Plastics Labs

Material Testing Report

SN 6641

ISOFIL HK 30 TXH0 NAT01

Lot# 2103304

Prepared for:

SIRMAX SPA

Via dell'artigianato 42

Cittadella

Italy

Prepared by:

Autodesk Moldflow Plastics Labs

2353 N. Triphammer Rd.

Ithaca, NY 14850

USA

Prepared on:

20 November, 2012

Report Authorized By:

Jeremy States

Laboratory Engineer

20 November, 2012

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ACCREDITED

Testing Cert. 2399.01

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Contents

Summary

Description

Family name	POLYPROPYLENES (PP)
Trade name	ISOFIL HK 30 TXH0 NAT01
Manufacturer	Sirmax SpA
Family abbreviation	PP
Material structure	Crystalline
Data source	Autodesk Moldflow Plastics Labs : pvT-Measured : mech-Measured
Date last modified	19-NOV-12
Date tested	19-NOV-12
Data status	Non-Confidential
Material ID	30946
Grade code	SN6641
Supplier code	SIRMAX
Fibers/fillers	30% Talc Filled

Recommended Processing

Mold surface temperature	30	°C
Melt temperature	220	°C

Mold temperature range (recommended)		
Minimum	25	°C
Maximum	40	°C

Melt temperature range (recommended)		
Minimum	200	°C
Maximum	240	°C

Absolute maximum melt temperature	270	°C

Ejection temperature	121	°C

Maximum shear stress	0.25	MPa
Maximum shear rate	100000	1/s

Maximum shear stress and maximum shear rate values have been supplemented with generic estimates.

Rheological Properties

Cross WLF Viscosity Model		
n	0.30585	
Tau	11754.5	Pa
D1	2.31468e+015	Pa-s
D2	263.15	K
D3	0	K/Pa
A1	31.183	
A2	51.600	K

Juncture loss method coefficients		
C1	1.229e-005	Pa^(1-c2)
C2	2.128	

Transition temperature		
Ttrans	129	°C

Moldflow Viscosity Index	VI(240)101	

Melt mass-flow rate (MFR)		
Temperature	230	°C
Load	2.16	Kg
Measured MFR	8.0	g/10min

Thermal Properties

Specific heat data		
Temperature (T) °C	Specific heat (Cp) J/Kg-°C	Heating/Cooling rate °C/s
230	2461.0	-0.33
195	2357.0	-0.33
160	2255.0	-0.33
133	2183.0	-0.33
129	2847.0	-0.33
125	13790.0	-0.33
121	5231.0	-0.33
119	3443.0	-0.33
115	2673.0	-0.33
102	2200.0	-0.33
80	1956.0	-0.33
60	1783.0	-0.33

Thermal conductivity data		
Temperature (T) °C	Thermal conductivity (k) W/m-°C	Heating/Cooling rate °C/s
234	0.269	0.0
225	0.287	0.0
215	0.296	0.0
196	0.300	0.0
177	0.296	0.0
138	0.305	0.0
79	0.303	0.0
38	0.305	0.0

PVT Properties

Melt density	0.9786	g/cm^3
Solid density	1.1770	g/cm^3

2-domain Tait PVT model coefficients		
b5	443.15	K
b6	1.195e-007	K/Pa
b1m	0.000986	m^3/Kg
b2m	7.084e-007	m^3/Kg-K
b3m	8.24878e+007	Pa
b4m	0.005855	1/K
b1s	0.000872	m^3/Kg
b2s	1.546e-007	m^3/Kg-K
b3s	2.25162e+008	Pa
b4s	0.003101	1/K
b7	0.000114	m^3/Kg
b8	0.025805	1/K
b9	7.777e-009	1/Pa

Mechanical Properties

Mechanical properties data		
Elastic modulus, 1st principal direction [E1]	3555	MPa
Elastic modulus, 2nd principal direction [E2]	3547	MPa
Poisson's ratio [v12]	0.3210	
Poisson's ratio [v23]	0.3210	
Shear modulus [G12]	1240	MPa

Transversely isotropic coefficient of thermal expansion [CTE] data		
Alpha1	5.850e-005	1/°C
Alpha2	6.310e-005	1/°C

Shrinkage Properties

Corrected residual in-mold stress (CRIMS) model coefficients	
A1	0.613119
A2	0.075343
A3	0.004981
A4	1.046753
A5	-0.239417
A6	0.007329

Residual strain model coefficients		
	Parallel	Perpendicular
A1	0.047399	0.090421
A2	0.001117	0.002338
A3	-0.000155	-0.000054
A4	1.0353e-007	1.4875e-007
A5	0.005442	0.007267

The shrinkage models shown above are valid for Autodesk Simulation Moldflow Insight 2013. Shrinkage models for previous software versions are included in the 21000.udb file.

Filler Properties

Filler data	
Description	Weight %
Talc	30

Viscosity

Method:
MPL Test Method
(Method falls outside the scope of A2LA Accreditation)

Instrument:
Arburg Allrounder 270S Injection Molding Machine

Test Specifications:

Sample Form:		Pellets
Pre-Processing:		Dried at 70°C for 1 hours in a hopper dryer
Moisture Level:		Not Measured
Capillary A:	Length:	32.4273 mm
	L/D:	16.21365
	Die Entry Angle:	90 degrees
Capillary B:	Length:	8.0505 mm
	L/D:	4.02525
	Die Entry Angle:	90 degrees
Barrel Diameter:		30 mm
Plastication Time:		20 sec
Dwell Time:		20 sec
Corrections:		Bagley, Rabinowitsch and shear heating
Date Received:		24-OCT-12
Date Tested:		07-NOV-12

Operator's Notes:
Testing was performed per standard testing procedures.
No anomalies were noted during the course of testing.

Apparent Viscosity Data

Temperature (°C)	Apparent Shear Rate (sec^{-1})	Apparent Viscosity (Pa-s)	Die Diameter (mm)	Die L/D
190.7	177	582.55	2	16.21
190.8	309	390.93	2	16.21
190.8	771	210.33	2	16.21
190.8	66151	14.4	2	16.21
190.9	1380	140.28	2	16.21
190.9	26375	27.56	2	16.21
191.2	2722	88.37	2	16.21
191.7	13221	38.28	2	16.21
192.8	6691	51.82	2	16.21
210.1	181	472.86	2	16.21
210.8	310	324.97	2	16.21
211.6	26625	18.02	2	16.21
211.7	1389	116.86	2	16.21
211.8	795	170.63	2	16.21
211.8	65838	12.33	2	16.21
212.0	2694	74.52	2	16.21
212.6	6707	40.64	2	16.21
213.7	13170	26.78	2	16.21
231.7	181	416.9	2	16.21
231.8	304	294.8	2	16.21
231.8	772	156.06	2	16.21
231.8	26617	14.48	2	16.21
231.8	66143	8.9	2	16.21
232	1385	104.01	2	16.21
232.3	2671	66.33	2	16.21
232.5	6757	35.19	2	16.21
232.9	13231	22.65	2	16.21
251.8	187	344.56	2	16.21
251.8	311	246.1	2	16.21
252.8	793	131.96	2	16.21
252.8	13221	20	2	16.21
252.8	26387	12.78	2	16.21
252.8	66260	7.32	2	16.21
253	1388	90.5	2	16.21
253.2	2724	57.07	2	16.21
253.3	6778	30.96	2	16.21
191.4	309	505.8	2	4.03
191.5	771	291.53	2	4.03
192	177	720.8	2	4.03
192.4	1380	203.51	2	4.03
192.5	13221	58.17	2	4.03
193	26375	39.16	2	4.03
194	2722	134.76	2	4.03
194.9	66151	25.65	2	4.03
195.6	6691	83.81	2	4.03
213.1	795	228.13	2	4.03
213.7	1389	162.98	2	4.03
213.9	26625	32.07	2	4.03
214	310	406.77	2	4.03
214	2694	109.36	2	4.03
214.2	13170	46.24	2	4.03

Temperature (°C)	Apparent Shear Rate (sec^{-1})	Apparent Viscosity (Pa-s)	Die Diameter (mm)	Die L/D
214.9	65838	20.4	2	4.03
215	181	568.24	2	4.03
215.3	6707	65.68	2	4.03
234	772	203.84	2	4.03
234	1385	141.46	2	4.03
234.2	304	361.87	2	4.03
234.5	2671	95.05	2	4.03
235	181	497.15	2	4.03
235	13231	38.72	2	4.03
235	26617	26.7	2	4.03
235	66143	16.82	2	4.03
235.2	6757	55.36	2	4.03
255.9	1388	119.72	2	4.03
256	2724	79.46	2	4.03
256	6778	46.93	2	4.03
256	13221	32.89	2	4.03
256.1	793	167.34	2	4.03
256.9	66260	14.25	2	4.03
257	187	394.14	2	4.03
257	311	292.12	2	4.03
257	26387	23.18	2	4.03

Calculated Viscosity Data

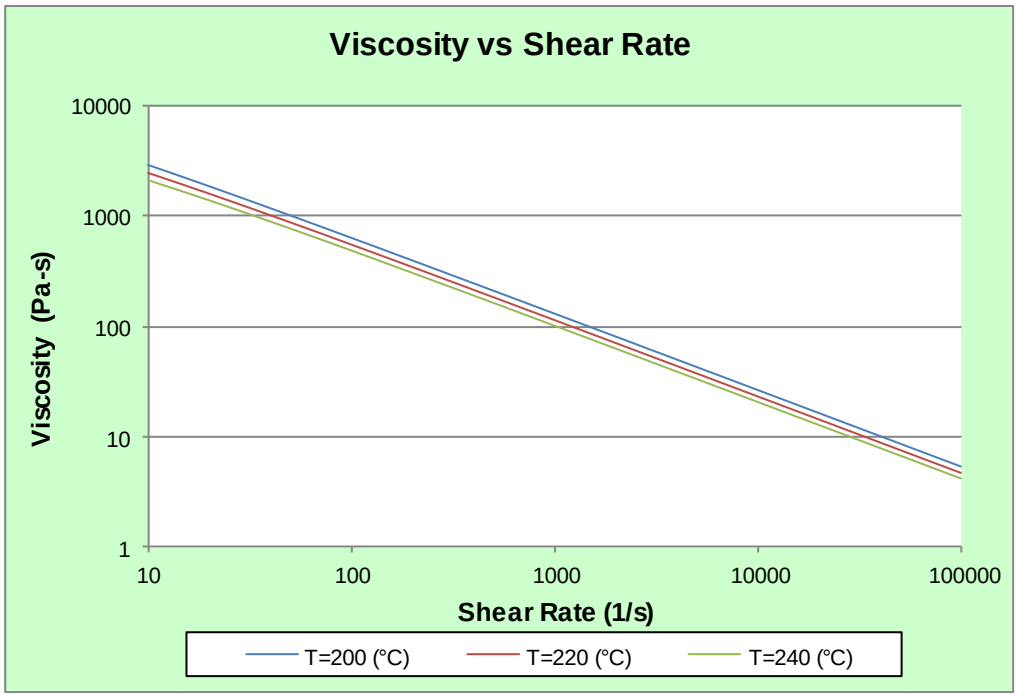
Temperature (°C)	Shear Rate (sec^{-1})	Calculated Viscosity (Pa-s)
190.7	177	461.4
190.8	771	167.27
190.8	309	314.35
190.8	66151	7.64
190.9	26375	14.45
190.9	1380	111.74
191.2	2722	69.64
191.4	309	312.87
191.5	771	166.36
191.7	13221	23.19
192	177	456.69
192.4	1380	110.45
192.5	13221	23.05
192.8	6691	36.88
193	26375	14.22
194	2722	68.17
194.9	66151	7.41
195.6	6691	36.11
210.1	181	393.61
210.8	310	270.98
211.6	26625	12.38
211.7	1389	95.79
211.8	795	140.75
211.8	65838	6.6
212	2694	60.45
212.6	6707	32.01
213.1	795	139.54
213.7	13170	19.9
213.7	1389	94.54
213.9	26625	12.2
214	310	265.21
214	2694	59.66
214.2	13170	19.84
214.9	65838	6.47
215	181	380.72
215.3	6707	31.45
231.7	181	342.53
231.8	772	126.8
231.8	304	240.4
231.8	26617	10.94
231.8	66143	5.82
232	1385	84.64
232.3	2671	53.66
232.5	6757	28.19
232.9	13231	17.65
234	1385	83.67
234	772	125.2
234.2	304	237.04
234.5	2671	52.99
235	181	335.88
235	13231	17.44

Temperature (°C)	Shear Rate (sec^{-1})	Calculated Viscosity (Pa-s)
235	66143	5.71
235	26617	10.74
235.2	6757	27.76
251.8	187	299.11
251.8	311	211.8
252.8	793	111.03
252.8	13221	15.88
252.8	26387	9.84
252.8	66260	5.19
253	1388	75.45
253.2	2724	47.32
253.3	6778	25.17
255.9	1388	74.36
256	2724	46.67
256	13221	15.63
256	6778	24.84
256.1	793	109.2
256.9	66260	5.09
257	187	291.08
257	26387	9.64
257	311	206.21

Rheological Data

Cross WLF Viscosity Model		
n	0.30585	
Tau	11754.5	Pa
D1	2.31468e+015	Pa-s
D2	263.15	K
D3	0	K/Pa
A1	31.183	
A2	51.600	K

Juncture loss method coefficients		
C1	1.229e-005	Pa^(1-c2)
C2	2.128	



Thermal conductivity

Method:

ASTM D 5930, Standard Test Method for Thermal Conductivity of Plastics by Means of a Transient Line-Source Technique.

Instrument:

Moldflow K-System II

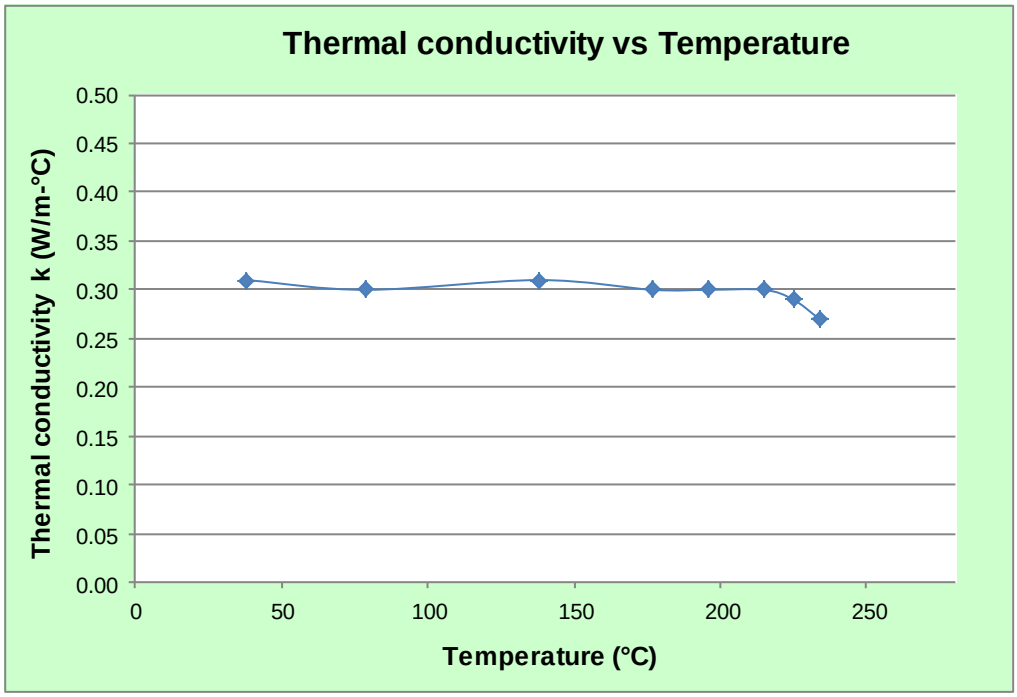
Test Specifications:

Sample Form:	Pellets
Pre-Processing:	Dried at 70°C for 1 hours in a hopper dryer
Moisture Level:	Not Measured
Probe Constant:	0.7156
Probe Length:	45 mm
Data acquisition time:	45 sec
Probe Voltage:	3.0 V
Date Received:	24-OCT-12
Date Tested:	08-NOV-12

Operator's Notes:

Testing was performed per standard testing procedures.
No anomalies were noted during the course of testing.

Thermal conductivity data		
Temperature (T) °C	Thermal conductivity (k) W/m-°C	Heating/Cooling rate °C/s
234	0.269	0.0
225	0.287	0.0
215	0.296	0.0
196	0.300	0.0
177	0.296	0.0
138	0.305	0.0
79	0.303	0.0
38	0.305	0.0



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Specific heat

Method:

ASTM E 1269, Standard Test Method for Determining Specific Heat Capacity by Differential Scanning Calorimetry
ASTM D 3418, Standard Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry

Instrument:

Perkin Elmer Pyris Diamond Differential Scanning Calorimeter

Test Specifications:

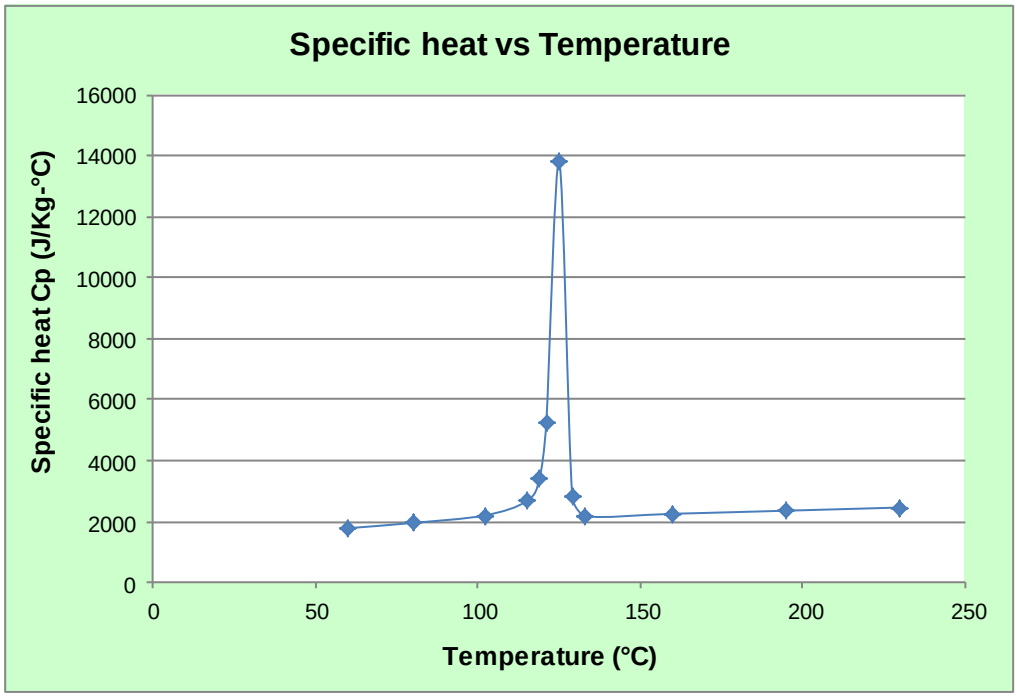
Sample Form:	Pellets
Pre-Processing:	Dried at 70°C for 1 hours in a hopper dryer
Moisture Level:	Not Measured
Initial Temperature:	240°C
Final Temperature:	40°C
Cooling Rate:	20°C/min
Equilibrium Time:	3 min
Sample holder material:	Aluminum
Sample holder dimensions:	6.7 mm diameter, 1.6 mm tall
Sample holder mass:	25 mg (pan + lid)
Purge gas:	99.99% pure nitrogen
Purge gas flow rate:	30 cm^3/sec
Date Received:	24-OCT-12
Date Tested:	07-NOV-12

Operator's Notes:

Testing was performed per standard testing procedures.
No anomalies were noted during the course of testing.

Specific heat data		
Temperature (T) °C	Specific heat (Cp) J/Kg-°C	Heating/Cooling rate °C/s
230	2461.0	-0.33
195	2357.0	-0.33
160	2255.0	-0.33
133	2183.0	-0.33
129	2847.0	-0.33
125	13790.0	-0.33
121	5231.0	-0.33
119	3443.0	-0.33
115	2673.0	-0.33
102	2200.0	-0.33
80	1956.0	-0.33
60	1783.0	-0.33

Ttrans	129	°C
Ejection temperature	121	°C



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Pressure-Volume-Temperature

Method:
High Pressure Indirect Dilatometry

Instrument:
Gnomix pvT Apparatus

Test Specifications:

Sample Form**:**	Molded Plaque
Pre-Processing**:**	Not required
Scan type**:**	Isothermal Cooling
Date Received:	24-OCT-12
Date Tested**:**	13-NOV-12

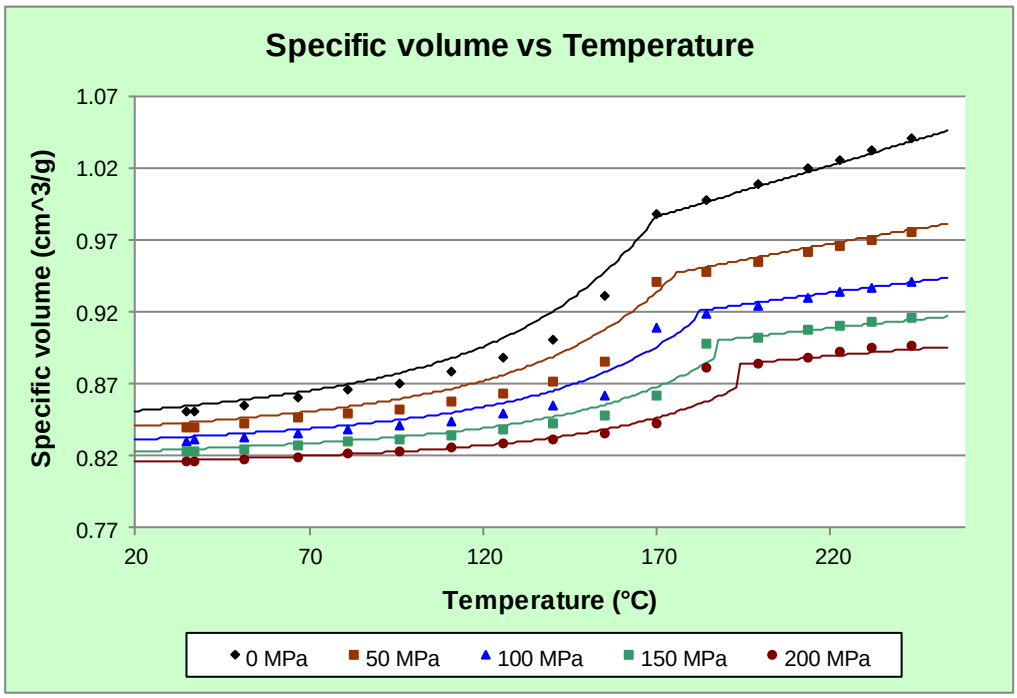
Operator's Notes:
Testing was performed per standard testing procedures.
No anomalies were noted during the course of testing.

pvT Experimental Data

Temperature (°C)	Pressure (MPa)				
	0MPa	50MPa	100MPa	150MPa	200MPa
34.69	0.8512	0.8399	0.8305	0.8227	0.8157
36.88	0.8514	0.8399	0.8308	0.8230	0.8159
51.47	0.8554	0.8428	0.8331	0.8250	0.8175
66.69	0.8601	0.8460	0.8356	0.8272	0.8192
81.36	0.8653	0.8493	0.8385	0.8294	0.8216
95.88	0.8705	0.8524	0.8407	0.8316	0.8232
110.9	0.8778	0.8573	0.8443	0.8343	0.8256
125.8	0.8877	0.8633	0.8488	0.8378	0.8282
140.5	0.9011	0.8721	0.8546	0.8419	0.8315
155.2	0.9309	0.8856	0.8625	0.8473	0.8352
169.9	0.9882	0.9410	0.9095	0.8623	0.8428
184.6	0.9979	0.9477	0.9190	0.8982	0.8808
199.1	1.0080	0.9545	0.9243	0.9026	0.8846
213.5	1.0190	0.9612	0.9296	0.9072	0.8887
222.8	1.0250	0.9653	0.9334	0.9103	0.8919
232.3	1.0320	0.9698	0.9367	0.9135	0.8946
243.5	1.0410	0.9751	0.9404	0.9163	0.8968

Melt density	0.9786	g/cm^3
Solid density	1.1770	g/cm^3

2-domain Tait PVT model coefficients		
b5	443.15	K
b6	1.195e-007	K/Pa
b1m	0.000986	m^3/Kg
b2m	7.084e-007	m^3/Kg-K
b3m	8.24878e+007	Pa
b4m	0.005855	1/K
b1s	0.000872	m^3/Kg
b2s	1.546e-007	m^3/Kg-K
b3s	2.25162e+008	Pa
b4s	0.003101	1/K
b7	0.000114	m^3/Kg
b8	0.025805	1/K
b9	7.777e-009	1/Pa



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Shrinkage

Method:
MPL Shrinkage Test Method (QOP-17-M)
(Method falls outside the scope of A2LA Accreditation)

Instrument:
Krauss Maffei KM160-750CX Injection molding machine
Test mold inscribed with a fine grid pattern
Temperature and Humidity Controlled Room
OGP Smartscope Flash 400 metrology system

Test Specifications:

Sample Form**:**	Pellets
Pre-Processing**:**	Dried at 70°C for 1 hours in a hopper dryer
Moisture Level**:**	Not Measured
Date Molded**:**	07-NOV-12
Post-Processing**:**	Conditioned at 23°C / 50% relative humidity for 7 days
Date Measured**:**	14-NOV-12
Shrinkage Data Correlated With**:**	Autodesk Simulation Moldflow Insight 2013
Default Model**:**	Residual Stress (CRIMS)
Date Received:	24-OCT-12

Operator's Notes:
Testing was performed per standard testing procedures.
No anomalies were noted during the course of testing.
Shrinkage measurements have been corrected to account for mold thermal expansion.
Data for some process conditions may have been removed in the determination of the favored model.

Shrinkage Experimental Data

Process Condition	Melt Temperature (°C)	Mold Temperature (°C)	Flow Rate (cc/sec)	Part Thickness (mm)	Packing Pressure (MPa)	Packing Time (sec)	Cooling Time (sec)
1	220.6	41.1	38.5	2	20.3	15	10
2	220.5	40.8	37.4	2	49.7	15	10
3	220.7	36.0	37.4	2	79.2	15	10
4	220.6	38.4	17.2	2	49.6	15	10
5	220.6	41.2	52.9	2	49.9	15	10
6	203.7	39.9	38.5	2	20.2	15	10
7	203.5	36.3	38.5	2	49.8	15	10
8	203.7	36.9	34.3	2	79.3	15	10
9	203.8	40.1	17.9	2	49.3	15	10
10	203.8	42.0	55.2	2	49.8	15	10
11	234.5	39.9	35.3	2	20.2	15	10
12	233.6	42.9	36.3	2	49.7	15	10
13	233.1	37.1	35.3	2	79.3	15	10
14	232.9	37.7	17.2	2	50.3	15	10
15	232.9	40.4	55.2	2	49.7	15	10
16	220.4	41.0	28.8	1.5	20.1	10	10
17	220.5	37.2	28.0	1.5	49.6	10	10
18	220.7	36.7	28.8	1.5	79.1	10	10
19	220.3	38.2	14.2	1.5	49.4	10	10
20	220.6	40.4	45.3	1.5	49.6	10	10
21	220.4	42.6	43.7	3	20.2	25	10
22	220.5	38.1	41.8	3	39.8	25	10
23	220.6	39.0	44.7	3	59.5	25	10
24	220.4	41.8	19.8	3	39.9	25	10
25	220.4	38.6	62.0	3	39.8	25	10

Part Shrinkage

Process Condition	Average Measured Parallel	Average Measured Perpendicular	Average Predicted Volumetric
1	1.047%	1.425%	7.088%
2	0.920%	1.066%	3.144%
3	0.735%	0.835%	1.686%
4	0.966%	1.092%	3.108%
5	0.887%	1.054%	3.133%
6	1.095%	1.421%	7.254%
7	0.961%	1.096%	3.189%
8	0.813%	0.841%	1.734%
9	1.011%	1.101%	3.214%
10	0.955%	1.103%	3.207%
11	1.022%	1.437%	6.954%
12	0.888%	1.063%	3.093%
13	0.685%	0.841%	1.650%
14	0.921%	1.106%	3.015%
15	0.855%	1.066%	3.092%
16	1.087%	1.321%	8.745%
17	0.992%	1.046%	3.942%
18	0.863%	0.870%	2.349%
19	1.103%	1.131%	3.843%
20	0.963%	1.054%	3.950%
21	0.981%	1.436%	4.528%
22	0.882%	1.170%	3.019%
23	0.752%	0.978%	2.083%
24	0.912%	1.206%	3.058%
25	0.867%	1.170%	3.023%

Residual Stress Coefficients

Corrected residual in-mold stress (CRIMS) model coefficients	
A1	0.613119
A2	0.075343
A3	0.004981
A4	1.046753
A5	-0.239417
A6	0.007329

Residual Strain Coefficients

Parallel				
	Coefficient	Lower Limit	Upper Limit	Centroid
1	0.047399	0.012444	0.096859	0.035915
2	0.001117	0.083906	0.63342	0.33845
3	-0.000155	10.462	27.019	18.288
4	1.0353e-007	23621.00	67558.00	43524.00
5	0.005442	0	0	0

Perpendicular				
	Coefficient	Lower Limit	Upper Limit	Centroid
1	0.090421	0.012444	0.096859	0.0358
2	0.002338	0.083906	0.63342	0.33375
3	-0.000054	10.462	27.019	18.45
4	1.4875e-007	3428.80	9311.50	5612.00
5	0.007267	0	0	0

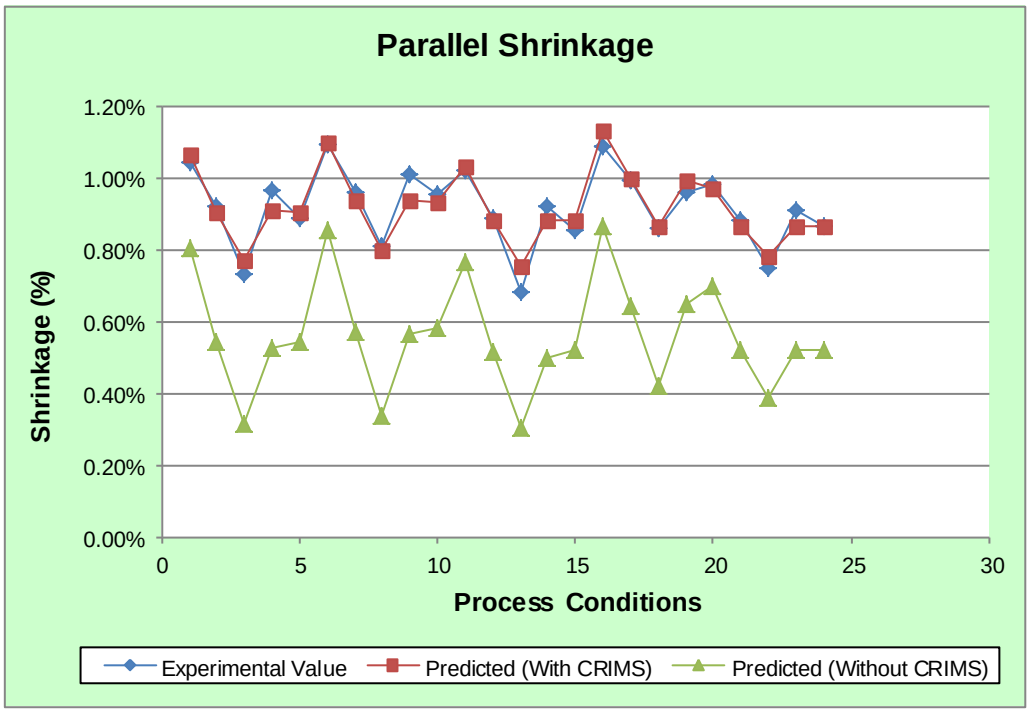
The shrinkage models shown above are valid for Autodesk Simulation Moldflow Insight 2013. Shrinkage models for previous software versions are included in the 21000.udb file.

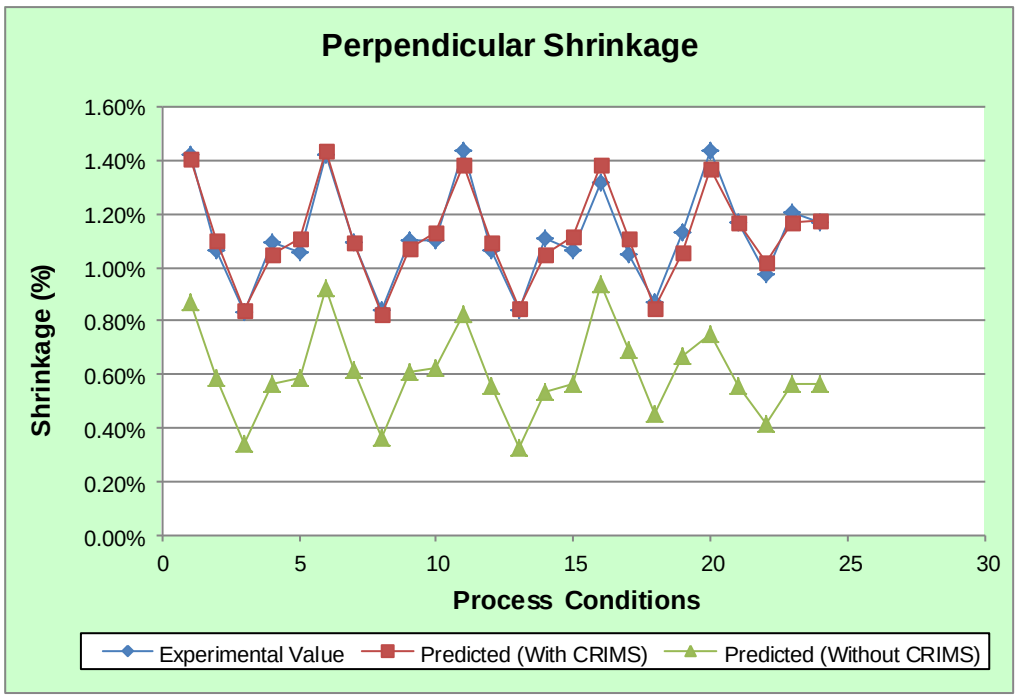
Observed Shrinkage

Observed nominal shrinkage	
Parallel	0.927%
Perpendicular	1.117%

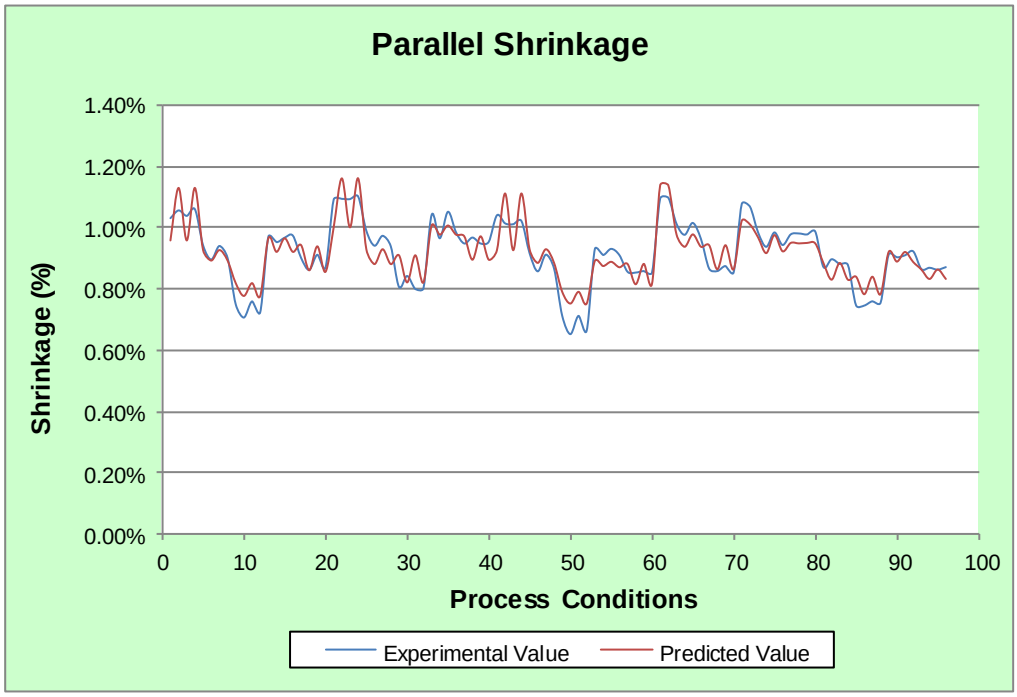
Observed shrinkage	
Minimum Parallel	0.685%
Maximum Parallel	1.103%
Minimum Perpendicular	0.835%
Maximum Perpendicular	1.437%

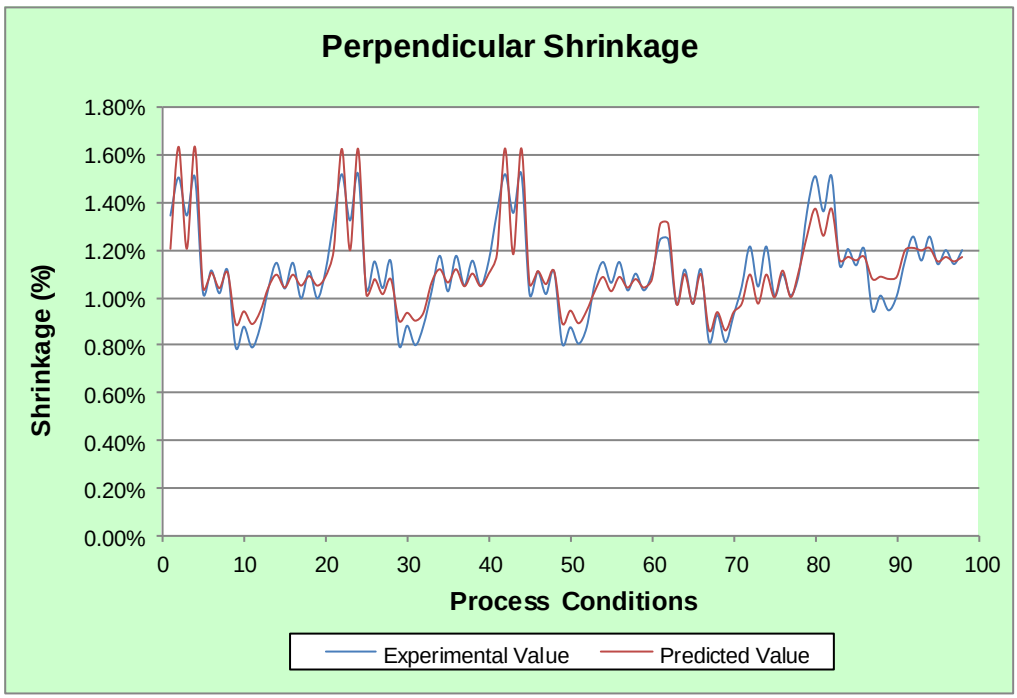
Residual Stress Plots





Residual Strain Plots





Mechanical

Elastic modulus and Poisson's ratio

Method:
ASTM D 638, Standard Test Method for Tensile Properties of Plastics
ASTM E 132, Standard Test Method for Poisson's Ratio at Room Temperature
(Method falls outside the scope of A2LA Accreditation)

Instrument:
MTS Sintech 5/G Universal Testing Machine

Test Specifications:

Specimens Tested:	8
Pre-Processing:	23°C +/-2°C at 50% +/-5% relative humidity for a minimum of 40 hours
Sample Form:	Machined from molded plaques
Test Speed:	5 mm/min
Date Received:	24-OCT-12
Date Tested:	12-NOV-12

Operator's Notes:
Testing was performed per standard testing procedures.
**Note: v23 values were slightly higher than expected, assuming isotropic behavior v23 was set equal to n12.

Elastic modulus		
Elastic modulus, 1st principal direction [E1]	3555	MPa
Elastic modulus, 2nd principal direction [E2]	3547	MPa

Poisson's ratio		
Poisson's ratio [v12]	0.3210	
**Poisson's ratio [v23]	0.3210	

Shear modulus

Method:

ASTM D 638, Standard Test Method for Tensile Properties of Plastics
(Method falls outside the scope of A2LA Accreditation)

Instrument:

MTS Sintech 5/G Universal Testing Machine

Test Specifications:

Specimens Tested:	8
Pre-Processing:	23°C +/-2°C at 50% +/-5% relative humidity for a minimum of 40 hours
Sample Form:	Machined from molded plaques
Test Speed:	5 mm/min
Date Received:	24-OCT-12
Date Tested:	12-NOV-12

Operator's Notes:

Shear modulus is calculated using orthotropic elasticity from the tensile modulus measured on a sample cut at an angle of 45° with the flow direction.
Testing was performed per standard testing procedures.
No anomalies were noted during testing.

Shear modulus		
Shear modulus [G12]	1240	MPa

Coefficient of linear thermal expansion

Method:
QOP-11, Coefficient of Linear Thermal Expansion of Plastics

Instrument:
Quartz tube dilatometer per ASTM

Test Specifications:

Specimens Tested:	2 (per direction): test repeated 2 times per specimen
Pre-Processing:	23°C +/-2°C at 50% +/-5% relative humidity for a minimum of 40 hours
Sample Form:	Machined from molded plaques
Specimen Geometry:	Rectangular, 8mm x 50mm, full thickness
Temperature Range:	0°C to 60°C
Date Received:	24-OCT-12
Date Tested:	12-NOV-12

Operator's Notes:
Testing was performed per standard testing procedures.
No anomalies were noted during testing.

Transversely isotropic coefficient of thermal expansion [CTE] data		
Alpha 1	5.850e-005	1/°C
Alpha 2	6.310e-005	1/°C

ACCREDITED
Testing Cert. 2399.01

Mold verification

Method:
MPL Mold Verification Test Method (QOP-16-M)
(Method falls outside the scope of A2LA Accreditation)

Instrument:
Krauss Maffei KM160-750CX Injection Molding Machine

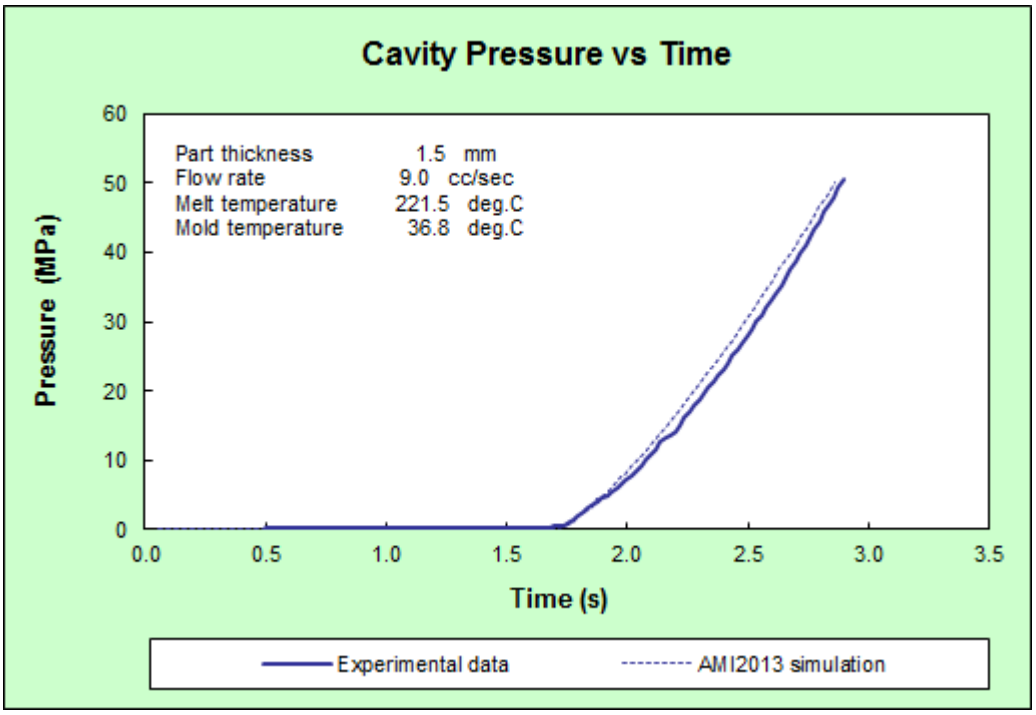
Test Specifications:

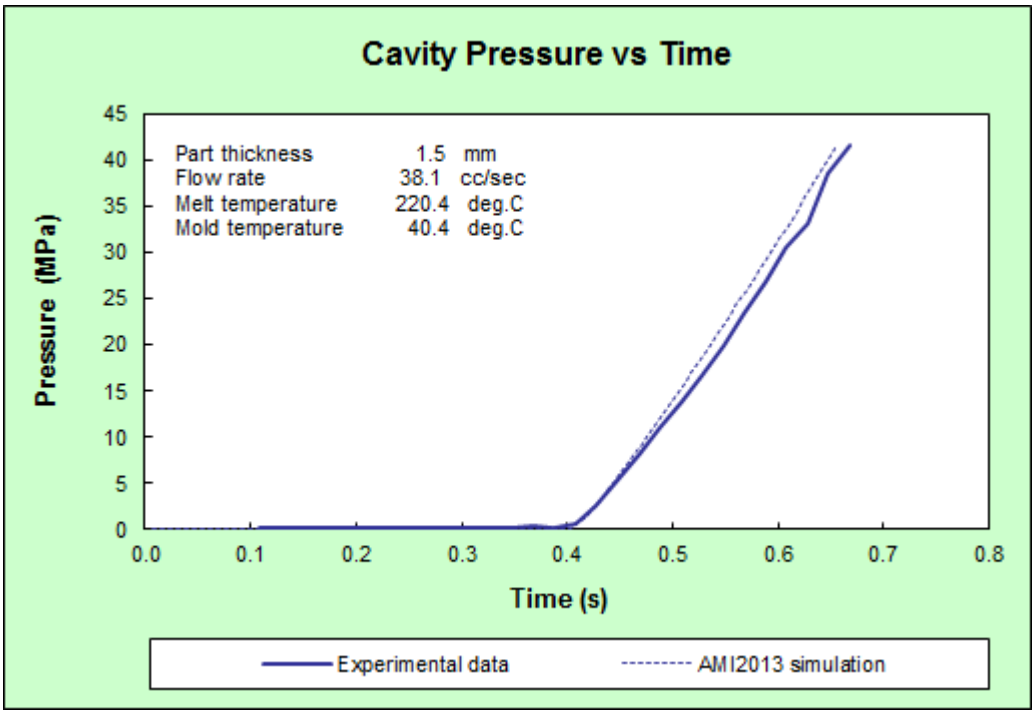
Sample Form:	Pellets
Pre-Processing:	Dried at 70°C for 1 hours in a hopper dryer
Moisture Level:	Not Measured
Date Received:	24-OCT-12
Date Tested:	07-NOV-12

Operator's Notes:
Testing was performed per standard testing procedures.
No anomalies were noted during the course of testing.

1.5mm tag die

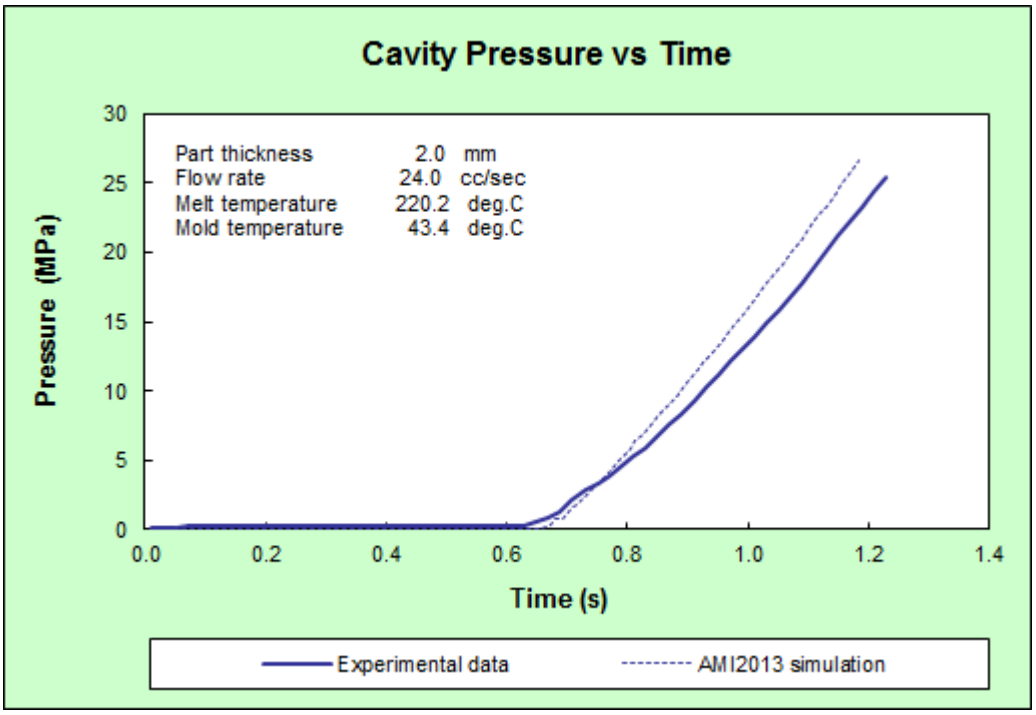
Experiment Number	Flow Rate (cc/sec)	Melt Temperature	Mold Temperature
Cyc0069	9	221.5	36.8
Cyc0078	38.1	220.4	40.4

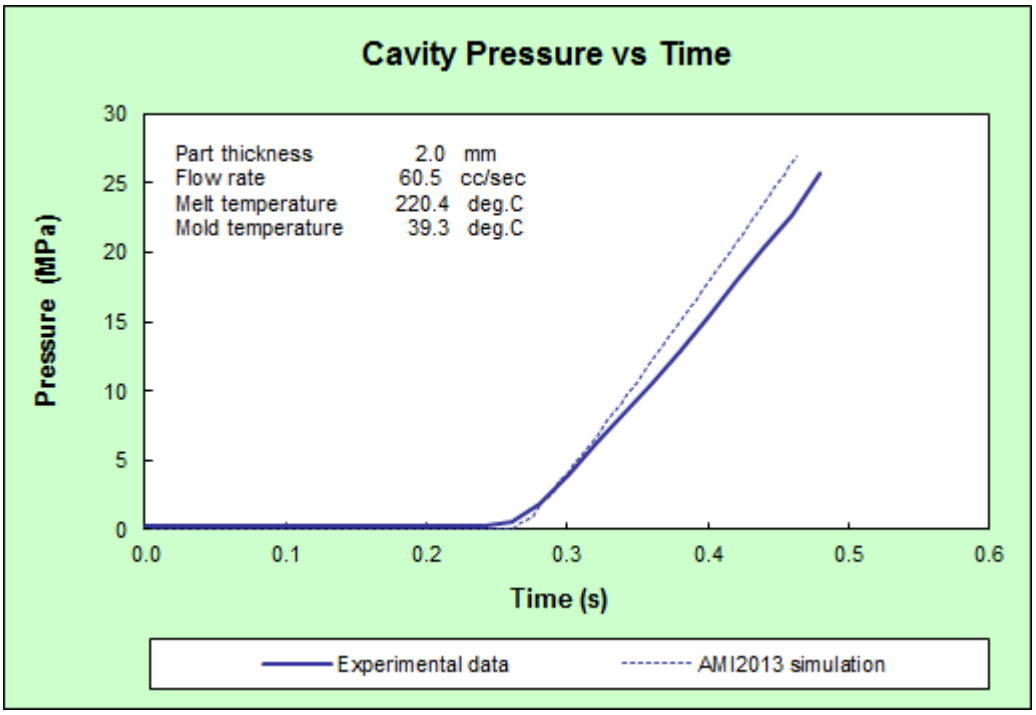




2mm tag die

Experiment Number	Flow Rate (cc/sec)	Melt Temperature	Mold Temperature
Cyc0008	24	220.2	43.4
Cyc0017	60.5	220.4	39.3

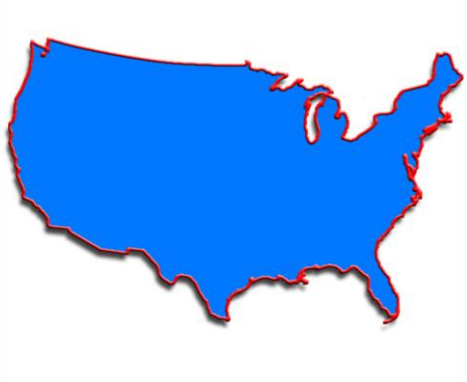




Contact details

United States of America

Autodesk Moldflow Plastics Labs
2353 North Triphammer Road
Ithaca, NY 14850
USA
Phone: +1-607- 266-7247
Fax: +1-607- 266-7100
Email: mplmoldflow@autodesk.com



Australia

Autodesk Moldflow Plastics Labs
259-261 Colchester Road
Kilsyth, Victoria, 3137
Australia
Phone: +61-3-9720-2088
Fax: +61-3-9729-0433
Email: mplmoldflow@autodesk.com

For testing enquiries please email mplmoldflow@autodesk.com

For data fitting and database enquiries please email datafittingmoldflow@autodesk.com

Autodesk's corporate website: www.autodesk.com